

NASA TECH BRIEF



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Determination of Diffusion Lengths in Silicon by an X-Ray Method

The problem:

The study of radiation damage in silicon solar cells has necessitated large numbers of measurements of diffusion lengths of the cells. The diffusion length is the distance that current carriers—free electrons or “holes” (the absence of electrons)—produced by illumination, move in the cell before being stopped by recombination. This length is important since, if a carrier does not reach the cell junction, it does not contribute to current flow in the cell. Measurements of diffusion lengths were previously made by a method which relied on the measurement of short-circuit current generated by electron beam radiation. The electron beam method required the use of an expensive bombardment facility and many man-hours of experimental work. Therefore, the amount of data obtainable on diffusion lengths was limited by practical considerations.

The solution:

The need for a rapid method of measuring diffusion lengths of silicon solar cells led to the development of a new procedure utilizing a standard X-ray machine. After the X-ray machine was calibrated with cells of known diffusion lengths, measurements on test cells could be made at the rate of one every two minutes with a standard deviation of less than two percent.

How it's done:

This procedure is not an absolute method for determining diffusion lengths since it depends on a comparison between test cells and calibration cells whose diffusion lengths have been measured accurately by another method. The calibration cells are pro-

duced by electron beam bombardment to various dosages, thereby altering their crystal structure and resulting in cells with different diffusion lengths covering a range from 5 to 200 microns. These diffusion lengths are determined as accurately as possible by a method using an electron beam. The resultant series of cells are used to calibrate an industrial-type X-ray machine for rapid diffusion length measurements on unknown cells.

A monitor cell is used to set the X-ray output to the same radiation value for all tests. Calibrated cells are exposed to the constant X-ray radiation and their current outputs per unit area are plotted against their known diffusion lengths. Current readings are then measured for the unknown cells with the same constant that X-ray output and diffusion lengths are read from the calibration curve.

Notes:

1. This method may be of interest for the determination of diffusion lengths in other semiconductor devices.
2. The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price \$3.00
(or microfiche \$0.65)

Reference:

NASA-TM-X-1894 (N69-37827), Diffusion
Lengths in Silicon Obtained by an X-Ray
Method

(continued overleaf)

3. Technical questions may be directed to:

Technology Utilization Officer

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Reference: B70-10150

Patent status:

No patent action is contemplated by NASA.

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Lewis Research Center

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